PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-044112

(43)Date of publication of application : 16.02.2001

(51)Int.Cl. H01L 21/027
G03F 7/20

(21)Application number : 11-215987

(22)Date of filing : 29.07.1999

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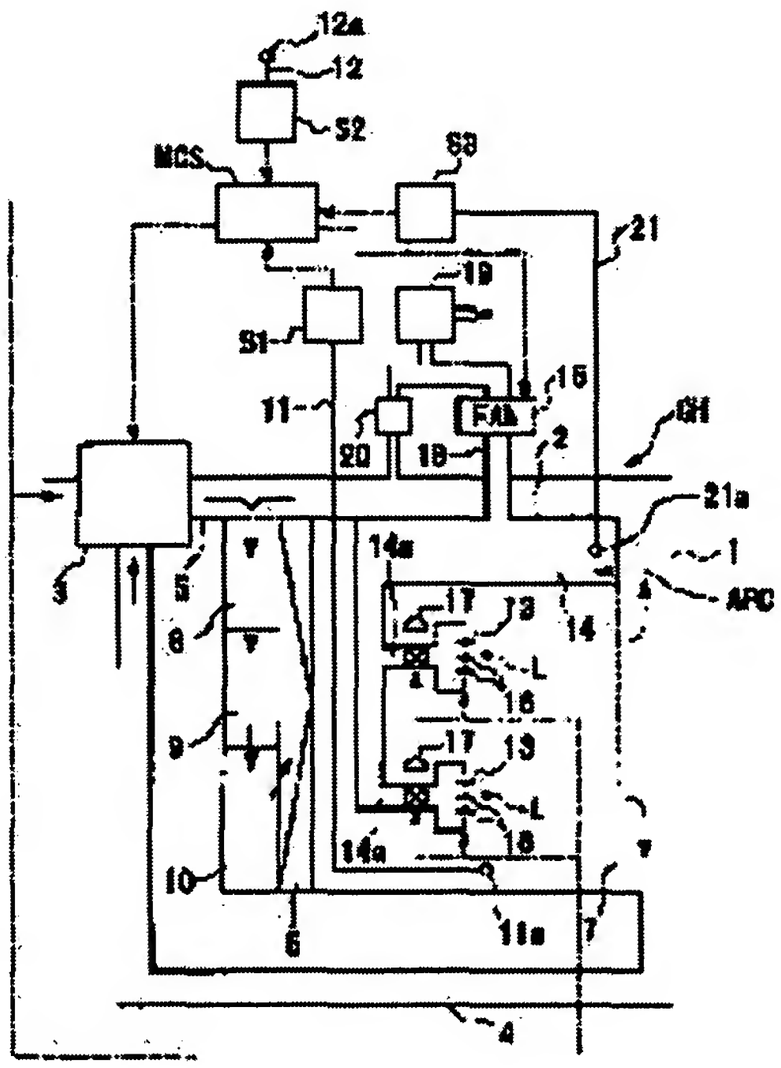
(54) ATMOSPHERIC PRESSURE CONTROL METHOD AND DEVICE THEREOF, LASER MEASURING DEVICE USING THE SAME, AND ALIGNER

(57)Abstract:

PROBLEM TO BE SOLVED: To measure coordinates more accurately by adjusting the speed of air flowing around an optical path and controlling an atmospheric pressure on the optical path according to a change in atmospheric pressure around the optical path of a light beam.

SOLUTION: A variable air fan 15, a variable shutter 16, and a variable valve 17 are controlled while connecting to a main control system MCS. That is, an atmospheric pressure variable mechanism composed of these members controls a difference between an inner atmospheric pressure and an atmospheric pressure of a pressurization chamber 14. Thus, it is possible to adjust air flow (speed of air and amount of air flow) from an air outlet 13. The air outlet 13 is disposed such that air flows orthogonally to an optical path L of a light beam, and the air outlet 13 is disposed along the optical path L. That is, since a difference in atmospheric pressure is made on the air outlet 13, appropriate air distribution is achieved without providing an air fan and so on in a chamber CH. With this arrangement, air flowing around the optical path L changes in speed, and an atmospheric pressure on the optical path L is controlled accordingly and held constant.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

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CLAIMS

[Claim(s)]
[Claim 1] The atmospheric pressure control method characterized by adjusting the rate of flow of the gas style which is the atmospheric pressure control method which controls the atmospheric pressure on the optical path of a light beam, and flows the aforementioned circumference of an optical path according to change of the atmospheric pressure of the aforementioned circumference of an optical path, and controlling the atmospheric pressure on the aforementioned optical path.
[Claim 2] It is the atmospheric pressure control method according to claim 2 characterized by for a light beam being a beam for measurement of the position metering device which measures the movement magnitude or the position of moving part arranged in a chamber, and adjusting the rate of flow of the aforementioned gas style based on the measured value of the atmospheric pressure sensor formed in the aforementioned chamber.
[Claim 3] The atmospheric-pressure control method which is the atmospheric pressure control method which controls within a chamber the atmospheric pressure on the optical path of the light beam used for arbitrary measurement, and is characterized by to change the blast weight or the amount of absorption of the aforementioned gas based on the amount of change of the atmospheric pressure in the aforementioned chamber, and to make regularity atmospheric pressure on the aforementioned optical path while ventilating or attracting the gas around the aforementioned optical path.
[Claim 4] The atmospheric-pressure control unit characterized by to have the gas style generating section which is the atmospheric-pressure control unit which controls the atmospheric pressure on the optical path of the light beam used for arbitrary measurement, and ventilates or attracts the gas around the aforementioned optical path within a chamber, the chamber atmospheric-pressure sensor which measure the atmospheric pressure in the aforementioned chamber, and the controlling mechanism which control the blast weight or the amount of absorption of the aforementioned gas style generating section based on the measurement result of this chamber atmospheric-pressure sensor.
[Claim 5] It is the atmospheric pressure control unit according to claim 4 which is equipped with the following and characterized by the aforementioned controlling mechanism controlling the aforementioned atmospheric pressure adjustable mechanism so that the differential pressure of the atmospheric pressure of the differential pressure interior of a room measured by the aforementioned differential pressure room atmospheric pressure sensor and the atmospheric pressure in the aforementioned chamber measured by the aforementioned chamber atmospheric pressure sensor becomes fixed. The aforementioned gas style generating section is a differential pressure room equipped with opening which is set as different atmospheric pressure in the aforementioned chamber, and is open for free passage in the aforementioned chamber. The atmospheric pressure adjustable mechanism in which the atmospheric pressure of this differential pressure room is changed. The differential pressure room atmospheric pressure sensor which measures the atmospheric pressure of the aforementioned differential pressure interior of a room.
[Claim 6] The aforementioned atmospheric pressure adjustable mechanism is an atmospheric pressure control unit according to claim 5 characterized by having the source of adjustable suction which can

change the amount of suction of the gas from the source of adjustable ventilation which is allotted to the exterior of the aforementioned chamber and can change the blast weight of the gas to the differential pressure interior of a room, or the differential pressure interior of a room.
[Claim 7] The aforementioned atmospheric pressure adjustable mechanism is an atmospheric pressure control unit according to claim 6 characterized by having at least one side of an adjustable bulb which is prepared in the passage of the gas the adjustable shutter which is formed in opening of the aforementioned differential pressure room, and changes the effective-area product of this opening, or near the opening, and changes the passage cross section of this passage.
[Claim 8] The laser metering device which is a laser metering device which project a light beam on the measurement object which can move, and the criteria section, respectively, and the reflected mutual reflected light is made to interfere, and measures the position of a measurement object, and is characterized by equipping either of the claims 4-7 with the atmospheric pressure control unit of a publication.
[Claim 9] movement which is the aligner which irradiates exposure light at a mask, projects the pattern on this mask on a substrate front face, and exposes it, and lays the aforementioned substrate with the movable mask stage which lays the aforementioned mask -- the aligner characterized by to have the laser metering device according to claim 8 which measures one [at least] position of a movable substrate stage, and the aforementioned mask stage or the aforementioned substrate stage

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the atmospheric pressure control method and equipment which are used in order to perform highly precise coordinate measurement etc., the laser metering device using this, and an aligner.
[0002]
[Description of the Prior Art] In the coordinate measurement used for alignment in an aligner, such as position measurement of a stage, and a substrate, etc., coordinate measurement is performed using the laser interferometer. Conventionally, for the improvement in the accuracy of measurement by this interferometer, it is known that the stability (the temperature in an optical path, atmospheric pressure, humidity stability) of the environment on the optical path of a light beam (laser beam) is important.
[0003] That is, into the light beam optical path of a laser interferometer, if air fluctuation arises, the refractive indices of air of an optical path will change, the wavelength of a light beam will change, and the accuracy of measurement will fall. For example, when the air environment in an optical path carries out minute amount change, relative variation ** lambda/lambda of the laser wavelength lambda can be expressed with the following formula (1) in approximation to change of temperature **T (degree C), atmospheric pressure **P (hPa), and humidity **H (%).
** lambda/lambda =(0.93**T+0.27**P-0.0098**H) x10-6 ... (1)
[0004] At this time, the measurement error over the measurement size L serves as the following formula (2).
L=Lx (lambda/lambda) ... (2)
For example, in order to permit measurement error **L<1mm temporarily to the measurement size of L= 500mm, you must be **T<0.022 degree C, **P<0.074hPa, and **H<2.01% (that to which calculation of each parameter fixed to for convenience, and performed other parameters).
[0005] Therefore, in order to obtain highly precise repeatability, control of measurement environment is indispensable and temperature and humidity are controlled from the turn of the ease of control. That is, measurement environment is controlled by the conventional coordinate measurement by the high precision chamber, the temperature in a chamber is controlled at **1/100 degree C, and humidity is controlled within 0.4%. The amount of measurement errors itself is stopped by the minute amount in under such measurement environment.
[0006] If it asks for relative variation ** lambda/lambda of the laser wavelength lambda from an approximation and asks for measurement error **L to the measurement size of L= 50mm, to **T=**1 / 100 degrees C, it will be set to **L=0.19nm to **L=0.93nm and **H=0.4(%). In an actual hygrometry, the humidity change by the humidity controller is **H=0.04(%) small 1 figure, and an amendment measurement error is set to **L=0.019nm, and it turns out that the relative variation of the laser wavelength lambda by humidity change is the thing of the grade which can be disregarded. Therefore, the error accompanying **1 / 100 (degree-C) temperature change, and atmospheric pressure change poses a problem. **1/100 degree C of especially the temperature-control capacity in a high precision

chamber is a limitation.
[0007] Then, the method of aiming at reduction of a measurement error is proposed by making fixed offset atmospheric pressure act on the atmospheric pressure control by the atmospheric pressure control chamber, i.e., the airtight interior of a room, between open air atmospheric pressure, and controlling the short chronotropism of open air atmospheric pressure from a viewpoint of the above-mentioned theoretical formula (1), to 0.074 or less hPas conventionally. Moreover, since generation of heat of the illumination system of the measuring instrument installed in the interior of a chamber or an electric processor etc. caused air fluctuation and has caused refractive-index change of an optical path, in order to make the air fluctuation of an interferometer optical path ease, it was ventilating by two or more sets of DC fan motors.
[0008]
[Problem(s) to be Solved by the Invention] However, coordinate measurement reproducibility was not able to be made under into 2nm (3sigma) made into a target in the above-mentioned conventional atmospheric pressure control means. That is, although based also on the kind of fan who is ventilating, the noise by rotation of the wing of fan motor heat or a fan generated from the motor of a fan posterior part was able to become air fluctuation and an electrical signal noise component, and the amount of measurement errors was not able to be reduced. Thus, the atmospheric pressure in a chamber was changed according to a cause different from change of open air atmospheric pressure, and there was a limitation in the atmospheric pressure control in the chamber by the conventional atmospheric pressure control chamber.
[0009] this invention was made in view of the above-mentioned technical problem, and aims at offering the atmospheric pressure control method which can perform highly precise coordinate measurement and equipment, the laser metering device using this, and an aligner.
[0010]
[Means for Solving the Problem] The following composition was used for this invention in order to solve the aforementioned technical problem. That is, if it matches and explains to drawing 3 from drawing 1 , it is the atmospheric-pressure control method which controls the atmospheric pressure on the optical path (L) of a light beam, and according to change of the atmospheric pressure of the aforementioned circumference of an optical path, the rate of flow of the gas style which flows the aforementioned circumference of an optical path will be adjusted, and the technology which controls the atmospheric pressure on the aforementioned optical path will be adopted by the atmospheric-pressure control method according to claim 1.
[0011] By adjusting the rate of flow of the flowing gas style, and changing the circumference of an optical path according to change of the atmospheric pressure of the circumference of an optical path (L), the rate of flow of the gas style on an optical path can be controlled by this atmospheric pressure control method, and the atmospheric pressure on an optical path can be controlled by it with high precision in connection with it.
[0012] It is the atmospheric-pressure control method which controls the atmospheric pressure on the optical path (L) of the light beam used for arbitrary measurement within a chamber (CH), and while ventilating or attracting the gas around the aforementioned optical path, by the atmospheric-pressure control method according to claim 3, the technology which changes the blast weight or the absorbed dose of the aforementioned gas based on the amount of the atmospheric pressure in the aforementioned chamber of change, and makes regularity the atmospheric pressure on the aforementioned optical path is adopted.
[0013] Moreover, it is the atmospheric pressure control unit (APC) which controls the atmospheric pressure on the optical path (L) of the light beam used for arbitrary measurement within a chamber (CH) by the atmospheric pressure control unit according to claim 4. The gas style generating section which ventilates or attracts the gas around the aforementioned optical path, and the chamber atmospheric pressure sensor which measures the atmospheric pressure in the aforementioned chamber (S1), Technology equipped with the controlling mechanism (MCS) which controls the blast weight or absorbed dose of the aforementioned gas style generating section based on the measurement result of

this chamber atmospheric pressure sensor is adopted.
[0014] With these atmospheric pressure control methods and equipment, while ventilating or attracting the gas around an optical path (L) Since a gaseous blast weight or the gaseous absorbed dose is controlled based on the amount of change of the atmospheric pressure in a chamber (CH) The atmospheric pressure control of the optical-path top can be carried out locally, the atmospheric pressure change on an optical path can be suppressed with high precision compared with the case where it is going to control the atmospheric pressure in [whole] a chamber uniformly, and the atmospheric pressure on an optical path can be held uniformly.
[0015] In a laser metering device according to claim 8, it is the measurement object (WST) which can move, and the laser metering device which project a light beam on the criteria section (PL), respectively, and the reflected mutual reflected light is made to interfere, and measures the position of a measurement object, and the technology which equips either of the claims 4-7 with the atmospheric pressure control unit (APC) of a publication is adopted.
[0016] In this laser metering device, since either of the claims 4-7 is equipped with the atmospheric pressure control unit (APC) of a publication, it becomes possible to suppress the atmospheric pressure change on the optical path of a light beam, and to perform highly precise position measurement by the laser beam.
[0017] The movable mask stage which is the aligner which irradiates exposure light at a mask (R), projects the pattern on this mask on a substrate (W) front face, and exposes it in an aligner according to claim 9, and lays the aforementioned mask (RST), movement which lays the aforementioned substrate -- technology equipped with the laser metering device (LM) according to claim 8 which measures one [at least] position of a movable substrate stage (WST), and the aforementioned mask stage or the aforementioned substrate stage is adopted
[0018] In this aligner, since it has the laser metering device (LM) according to claim 8 which measures one [at least] position of a mask stage (RST) or a substrate stage (WST), the influence of atmospheric pressure change is suppressed, with high precision, it can coordinate-measure and a mask or a substrate can be positioned.
[0019]
[Embodiments of the Invention] Hereafter, 1 operation form of the atmospheric pressure control method concerning this invention and equipment, the laser metering device using this, and an aligner is explained, referring to drawing 3 from drawing 1 .
[0020] Drawing 1 is drawing showing roughly the whole aligner composition in this operation form, and shows the aligner of the so-called step-and-repeat method or step -, and - scanning method. At this aligner, Reticle R is uniformly illuminated by the exposure light from the illumination system ILS for exposure in the state where it was held at the reticle stage RST. Image formation projection of the pattern drawn by Reticle R is carried out on the wafer W with which the sensitization agent was applied through the projection optical system PL.
[0021] Wafer W is laid on the wafer stage (a measurement object, moving part) WST which carries out two-dimensional movement in a perpendicular field to the optical axis AX of a projection optical system (criteria section) PL. In drawing 1 , the wafer stage WST moves in a base top about each with a direction perpendicular to the longitudinal direction in drawing, and space. In addition, the reticle stage RST and the projection optical system PL are attached in the column (illustration abbreviation) which was united with the base section of the wafer stage WST.
[0022] Moreover, in this aligner, the alignment system AA 1 of a TTR (Sulzer reticle) method or the alignment system AA 2 of a TTL (Sulzer lens) method is formed. The alignment system AA 1 is for carrying out alignment of the reticle R to the optical axis AX of a projection optical system PL, or carrying out alignment of the reticle R to Wafer W through a projection optical system PL, and the alignment system AA 2 is for carrying out alignment of the wafer W through a projection optical system PL. The various alignment information by these alignment systems AA1 and AA2 is sent to the main-control system (controlling mechanism) MCS, and is used for the desired value calculation for exact positioning of the wafer stage WST.

[0023] Moreover, in order to measure the position of the wafer stage WST, the laser metering device (position metering device) LM equipped with the atmospheric pressure control unit APC which controls the atmospheric pressure on the optical path L of the light beam (beam for measurement) used for a laser interferometer IFM and this laser interferometer IFM is formed.
[0024] A laser interferometer IFM is an intensity-modulation type interference-of-light-wave meter. a this intensity-modulation type interferometer While carrying out incidence at right angles to the move mirror which attached in the movable object the laser beam which is the coherent parallel flux of light by which frequency stabilization was carried out Incidence of the laser beam (parallel flux of light) is carried out at right angles also to the fixed mirror attached in the portion connected with the base section of a stage fixed, the beam reflected by each of a move mirror and a fixed mirror is made to interfere, and photoelectrical detection of the change of the interference fringe (fringe) is carried out.
[0025] Therefore, it can ask for the position of a stage by the light and darkness of a fringe changing repeatedly according to the wavelength and movement magnitude of a laser beam, if a stage moves, and changing into a digital pulse the photoelectrical signal (the shape of a sine wave) acquired at this time, and measuring by the counter. In addition, you may use a so-called frequency-modulation type interferometer as a laser interferometer IFM. A this frequency-modulation type interferometer gives a fixed delta frequency to the laser beam which goes to each of a move mirror and a fixed mirror, and measures the movement magnitude of a stage from the phase shift of the beat signal (difference frequency) acquired when the reflective beam from each of a move mirror and a fixed mirror is made to interfere and photoelectrical detection is carried out.
[0026] With this operation gestalt, as shown in drawing 1 , it is projected on the light beam from a laser interferometer IFM by the move mirror MS fixed to the wafer stage WST, and is projected on one light beam which will accept it from a laser interferometer IFM by the fixed mirror (reference mirror) MR fixed to the lens-barrel lower part of a projection optical system PL. The move mirror MS turns into a measured mirror in case the wafer stage WST moves to the longitudinal direction of drawing 1 , and the reflector of the move mirror MS is formed in the direction perpendicular to the space of drawing 1 long and slender.
[0027] Moreover, a laser interferometer IFM makes the light beam reflected from the fixed mirror MR, and the light beam reflected from the move mirror MS compound by the beam splitter BS, and contains the photodetector which receives the interference beam, the pulse converter which outputs an up-and-down pulse based on the photoelectrical signal. Reversible counting of the up-and-down pulse from this pulse converter is carried out by the updown counter in stage-control-system STD, and the position of the wafer stage WST is measured.
[0028] Furthermore, stage-control-system STD controls suitably the output signal to the motor MT which drives the wafer stage WST according to the measurement position by the updown counter. If the positioning desired value (coordinate value) outputted from the main-control system MCS is received, stage-control-system STD will move the wafer stage WST so that the current position of the wafer stage WST by which is detected by the laser interferometer IFM and counting is carried out by the updown counter may be in agreement by the desired value and fixed tolerance.
[0029] Moreover, even if there are few these aligners, each optical system, each stage, and each interferometer are contained in Chamber CH. As this chamber CH is shown in drawing 3 , the portion and the exterior which are held by the septum 1 are divided, and the circulation duct 2 which constitutes the air circulation system which circulates through the air in Chamber CH is formed in the septum 1.
[0030] Moreover, the suction duct 4 and the blowdown duct 5 which were connected to the outside tone machine 3 are connected to the septum 1 through the circulation duct 2. In addition, the outside tone machine 3 blows off adjusting the amount of supply, and supplies the open air to a duct 5. Furthermore, as for Chamber CH, a filter 6 and the exhaust air board 7 of each other are formed in a separate inside side, behind the filter 6, it connects with the circulation duct 2 and the cooler 8, the heater 9, and the circulation fan 10 are installed by this order.
[0031] That is, the air from the outside tone machine 3 and the air in the circulation duct 2 are inhaled to a cooler 8 and heater 9 side by the circulation fan 10, the humidity and temperature of air are controlled

by these, and this air is supplied in Chamber CH through a filter 6 by the circulation fan 10. This air is discharged by the circulation duct 2 and the suction duct 4 through the exhaust air board 7 from the inside of Chamber CH, and while the air which circulates the circulation duct 2 is again returned by the circulation fan 10 in Chamber CH, the air which circulates the suction duct 4 is returned to the outside tone machine 3.

[0032] While the inner atmospheric pressure induction 11 connected to the external inner atmospheric pressure sensor (chamber atmospheric pressure sensor) S1 is formed in Chamber CH, the outside atmospheric pressure induction 12 connected to the outside atmospheric pressure sensor S2 is formed out of the septum 1. That is, atmospheric pressure of Chamber CH inside and outside is carried out to the inner atmospheric pressure sensor S1 and the outside atmospheric pressure sensor S2 being detectable, respectively through the inner atmospheric pressure induction 11 and the outside atmospheric pressure induction 12.

[0033] The atmospheric pressure signal detected by these inside atmospheric pressure sensor S1 and the outside atmospheric pressure sensor S2 is transmitted to the main-control system MCS. In addition, the inner atmospheric pressure induction 11 consists of pipes, and the opening edge 11a is allotted to the circumference of the optical path L of a light beam while the sense is allotted so that the influence of the dynamic pressure by the flow of the air in Chamber CH may not arise.

[0034] Based on the atmospheric pressure signal of the inner atmospheric pressure from the inner atmospheric pressure sensor S1 and the outside atmospheric pressure sensor S2, and outside atmospheric pressure, the main-control system MCS controls opening and closing of the bulb for the open air introduction in the outside tone machine 3 so that the inner atmospheric pressure of Chamber CH holds setting atmospheric pressure only with high place constant pressure to outside atmospheric pressure.

[0035] This control method carries out place constant-pressure addition of the outside atmospheric pressure depended on the outside atmospheric pressure sensor S2 to the pressure value while computing a flat pressure value in the long run to change of the short time of outside atmospheric pressure by the signal converter in the main-control system MCS (illustration abbreviation), and it creates setting atmospheric pressure. And when the main-control system MCS controls the outside tone machine 3 based on the differential pressure of the measured inner atmospheric pressure and the setting atmospheric pressure for which it asked, the short period change in the inner atmospheric pressure of Chamber CH is suppressed.

[0036] Moreover, the atmospheric pressure control unit APC is equipped with the pressurized room (differential pressure room) 14 equipped with the ventilation mouth (opening) 13 which is set as different atmospheric pressure in Chamber CH, and is open for free passage in Chamber CH, and the pressurized-room atmospheric pressure sensor (differential pressure room atmospheric pressure sensor) S3 which measures the atmospheric pressure in a pressurized room 14. Moreover, it has the adjustable blower fan (source of adjustable ventilation) 15 which is allotted to the exterior of Chamber CH and can change the blast weight of the air into a pressurized room 14 as an atmospheric pressure adjustable mechanism in which the atmospheric pressure in a pressurized room 14 is changed, the adjustable shutter 16 which is formed in the ventilation mouth 13 and changes the effective-area product of this ventilation mouth 13, and the adjustable bulb 17 into which it is prepared in passage 14a of about 13 ventilation mouth air, and the passage cross section of this

[0037] It connects with the main-control system MCS, and these adjustable blower fan 15, the adjustable shutter 16, and the adjustable bulb 17 are controlled. That is, the ventilation (the rate of flow of air, blast weight) from the ventilation mouth 13 can be adjusted by controlling the differential pressure of inner atmospheric pressure and the atmospheric pressure in a pressurized room 14 by the atmospheric pressure adjustable mechanism which consists of these. The ventilation mouth 13 is arranged so that air may flow perpendicularly to the optical path L of a light beam, and it is prepared along with the optical path L. In addition, optical-path L absentminded mind fluctuation is reduced by controlling the flow of the air current of an optical path L perpendicularly uniformly horizontally to the travelling direction of a light beam.

[0038] An end side is connected to a pressurized room 14 through the ventilation duct 18, and the

aforementioned adjustable blower fan 15 is connected to the open air introduction electro-magnetic valve 19 to which an other end side introduces the open air into a pressurized room 14. In addition, the ventilation duct 18 is connected to the circulation duct 2 through the damper 20 for adjustment for adjusting the amount of pressurization air circulation. the aforementioned adjustable shutter 16 consists of wing members in which two or more rotations are possible, in order to perform uniform ventilation from the ventilation mouth 13 -- having -- these wings -- the effective-area product of the ventilation mouth 13 can be controlled now by adjusting the angle of rotation of a member

[0039] While the aforementioned pressurized-room atmospheric pressure sensor S3 is formed in the exterior of Chamber CH, it connects with the pressurized-room atmospheric pressure induction 21 which consisted of pipes, and, as for this pressurized-room atmospheric pressure induction 21, opening edge 21a at the nose of cam is allotted in the pressurized room 14. This pressurized-room atmospheric pressure sensor S3 is set up so that the atmospheric pressure signal of the pressurized room 14 detected through the pressurized-room atmospheric pressure induction 21 may be transmitted to the connected main-control system MCS.

[0040] In addition, drawing 2 shows the whole laser metering-device LM composition of the Tracker method which consisted of two interferometers of the optical path which is an amendment method and was made into the vacuum in the laser wavelength which changes by the environmental variation in the atmosphere, and the optical path in the atmosphere. The light beam (laser beam) from a laser light source LH is branched to wavelength Tracker 22 and the interferometer IFM of a couple by the beam splitter BS, and it is made to project a light beam on each move mirror MS the object for the directions of X of the wafer stage WST, and for the directions of Y from each interferometer IFM in this laser metering device LM (a sign 23 is a photodetector). In the slash field in drawing 2 , the ventilation mouth 13 is arranged, respectively so that the air fluctuation in the optical path L of the light beam in each field may be eased.

[0041] The atmospheric pressure control method on the optical path L of the light beam by this atmospheric pressure control unit APC is explained below.

[0042] First, if the inner atmospheric pressure of the circumference of optical-path L is changed, the amount of change of this inner atmospheric pressure will be detected by the inner atmospheric pressure sensor S1, and will be sent to the main-control section MCS. On the other hand, the atmospheric pressure in the pressurized room 14 at this time is also detected by the pressurized-room atmospheric pressure sensor S3, and is sent to the main-control section MCS. And the main-control section MCS adjusts the blast weight of the air from the ventilation mouth 13 based on the detected inner atmospheric pressure and the atmospheric pressure in a pressurized room 14.

[0043] That is, the main-control system MCS adjusts at least one of the amount of openings of the ventilation mouth 13 by the rotational frequency of the adjustable blower fan 15, and the adjustable shutter 16, and the passage cross sections of passage 14a by the adjustable bulb 17 so that the differential pressure of the atmospheric pressure in the pressurized room 14 measured by the pressurized-room atmospheric pressure sensor S3 and the atmospheric pressure in the chamber CH measured by the inner atmospheric pressure sensor S2 may become fixed.

[0044] For example, in order to blow atmospheric pressure inclination with the inside of a pressurized room 14 and Chamber CH upon an optical path L, the inside of a pressurized room 14 is pressurized so that it may become optimal blast-weight 0.3 mm/sec. That is, suitable ventilation is attained by producing an atmospheric pressure difference in the ventilation mouth 13, without installing a blower fan etc. in the interior of chamber CH. The blast weight from the ventilation mouth 13 is adjusted, the rate of flow of the airstream (gas style) which flows the circumference of optical-path L changes, the atmospheric pressure on an optical path L is controlled by this in connection with it, and it is held uniformly.

[0045] Thus, with this operation form, while suppressing the short period change in the inner atmospheric pressure of Chamber CH by controlling the outside tone machine 3, according to the atmospheric pressure change in the optical-path L circumference of the light beam used with the laser metering device LM, the rate of flow of the airstream which flows the circumference of optical-path L

can be adjusted, and the atmospheric pressure on an optical path L can be stabilized with the atmospheric pressure control unit APC. Moreover, according to the atmospheric pressure inclination of a pressurized room 14 and the inside of Chamber CH, since the air of a blast weight suitable on an optical path L can be sprayed, there is no need of preparing the fan for spraying air on an optical path L in Chamber CH, and generation of heat of an electric processor, and the noise and air fluctuation resulting from a fan can be eased and reduced.

[0046] Therefore, the nonlinear error by the atmospheric pressure change on a light beam optical path can be reduced, and while becoming possible to hold down coordinate measurement reproducibility to under 2nm (3sigma), acquiring the stable measurement environment and being able to perform coordinate measurement of the highly precise wafer stage WST, exposure precision can be raised by exact positioning.

[0047] In addition, this invention also includes the following operation forms. With the above-mentioned operation form, although the atmospheric pressure control unit APC was used for the laser metering device LM for coordinate measurement of the wafer stage WST, you may adopt as an object for the atmospheric pressure control on the optical path of the light beam used for coordinate measurement and the alignment system of a reticle stage RST.

[0048] Although the blast weight was changed based on the amount of change of the atmospheric pressure in Chamber CH and atmospheric pressure on an optical path L was fixed while ventilating the air around an optical path L, while attracting the air around an optical path L conversely, the amount of absorption may be changed based on the amount of change of the atmospheric pressure in Chamber CH, and atmospheric pressure on an optical path L may be fixed. In this case, what is necessary is just to use the adjustable suction fan who can change the amount of suction of air instead of an adjustable blower fan and who attracts the air in a decompression chamber and discharges outside as a source of adjustable suction, while preparing a decompression chamber instead of a pressurized room. In addition, in order to raise the directivity of the airstream attracted at this time, you may prepare the dashboard in alignment with the flow etc. near the optical path of a light beam. Moreover, when detecting the atmospheric pressure in Chamber CH, it is desirable to measure the atmospheric pressure near the optical path L.

[0049] Although only the ventilation mouth 13 is arranged near the optical-path L of a light beam and air is sprayed on the optical path L with the above-mentioned operation form, you may prepare the ventilation mouth of the above-mentioned pressurized room for an optical path in this covering using wrap covering like the position metering device indicated by JP,5-283313,A, for example.

[0050] Although the inside of a pressurized room was pressurized in the atmospheric pressure control in the above-mentioned operation form so that both the atmospheric pressure of a pressurized room and the atmospheric pressure in a chamber might be measured and the differential pressure of the atmospheric pressure of a pressurized room and the atmospheric pressure in a chamber might become fixed You may control the blast weight from a ventilation mouth by controlling an adjustable blower fan etc. according to the conditions set up beforehand, and pressurizing the inside of a pressurized room to measure only the atmospheric pressure in a chamber and to become the atmospheric pressure which added and asked this atmospheric pressure for fixed offset atmospheric pressure.

[0051] As an aligner of the above-mentioned operation gestalt, it can apply also to the proximity aligner which a mask and a substrate are made close instead of a reticle, and exposes the pattern of a mask, without using a projection optical system. It can apply also to the aligner for the liquid crystal which exposes a liquid crystal display element pattern on the glass plate of a square shape, and the aligner for manufacturing the thin film magnetic head widely, for example, without being limited to the aligner for semiconductor manufacture as a use of an aligner.

[0052] as mentioned above, the atmospheric pressure control unit and aligner of this application example -- this application -- various subsystems including each component (elements) mentioned to the claim (claims) are manufactured by assembling so that a predetermined mechanical precision, electric precision, and optical precision may be maintained In order to secure these various precision, before and after this assembly, adjustment for attaining electric precision is performed about the adjustment for attaining mechanical precision about the adjustment for attaining optical precision about various optical

system, and various mechanical systems, and various electric systems. Like the assembler from various subsystems to an aligner, the mechanical connections between [various] subsystems, wiring connection of an electrical circuit, piping connection of an atmospheric pressure circuit, etc. are included. It cannot be overemphasized that it is in the front like the assembler from these various subsystems to an aligner like the assembler of each subsystem each. If it ends like the assembler to the aligner of various subsystems, comprehensive adjustment will be performed and the various precision as the whole aligner will be secured. In addition, it is desirable to perform manufacture of an aligner in the clean room where temperature, the air cleanliness class, etc. were managed.

[0053] A semiconductor device is manufactured through the step which performs the functional ability design of a device, the step which manufactures the reticle based on this design step, the step which manufactures silicon material to a wafer, the step which exposes the pattern of a reticle to a wafer by the aligner of the operation form mentioned above, a device assembly step (a dicing process, a bonding process, and a package process are included), an inspection step, etc.

[0054]

[Effect of the Invention] According to this invention, the following effects are done so. According to the atmospheric pressure control method according to claim 1, by adjusting the rate of flow of the flowing gas style, and changing the circumference of an optical path according to change of the atmospheric pressure of the circumference of an optical path, the rate of flow of the gas style on an optical path can be controlled, and the atmospheric pressure on an optical path can be controlled with high precision in connection with it. By this, atmospheric pressure change becomes possible [suppressing the influence which it has on a light beam].

[0055] According to the atmospheric pressure control method according to claim 2, it is the beam for measurement of the position metering device with which a light beam measures the movement magnitude or the position of moving part arranged in a chamber. Since the rate of flow of a gas style is adjusted based on the measured value of the atmospheric pressure sensor formed in the chamber While being able to suppress the atmospheric pressure change on the optical path of the beam for measurement with high precision by surveying atmospheric pressure change in a chamber by the atmospheric pressure sensor, the coordinate measurement reproducibility of a position metering device can be raised.

[0056] Since according to the atmospheric pressure control method according to claim 3 and the atmospheric pressure control unit according to claim 4 a gaseous blast weight or the gaseous amount of absorption is controlled based on the amount of change of the atmospheric pressure in a chamber while ventilating or attracting the gas around an optical path, compared with the case where it is going to control the atmospheric pressure in [whole] a chamber uniformly, the atmospheric pressure on an optical path can be held uniformly with high precision and simply.

[0057] Since according to the atmospheric pressure control unit according to claim 5 an atmospheric pressure adjustable mechanism is controlled so that the differential pressure of the atmospheric pressure of the differential pressure interior of a room which the controlling mechanism measured by the differential pressure room atmospheric pressure sensor, and the atmospheric pressure in the chamber measured by the chamber atmospheric pressure sensor becomes fixed Even if it changes the atmospheric pressure in a chamber, by controlling the above-mentioned differential pressure uniformly, a blast weight or the amount of suction is adjusted appropriately, and can always control the atmospheric pressure on an optical path uniformly.

[0058] Since the atmospheric pressure adjustable mechanism is equipped with the source of adjustable suction which can change the amount of suction of the gas from the source of adjustable ventilation which is allotted to the exterior of a chamber and can change the blast weight of the gas to the differential pressure interior of a room, or the differential pressure interior of a room according to the atmospheric pressure control unit according to claim 6 Compared with the case where the source of adjustable ventilation or the source of adjustable suction is allotted the differential pressure interior of a room or in the chamber, there are little the noise and the thermal influence by these, and the atmospheric pressure control of them is attained in the environment stabilized more.

[0059] Since it has at least one side of an adjustable bulb which an atmospheric pressure adjustable

mechanism is prepared in the passage of the gas the adjustable shutter which is formed in opening of a differential pressure room and changes the effective-area product of this opening, or near the opening, and changes the passage cross section of this passage according to the atmospheric pressure control unit according to claim 7, simple composition can adjust the atmospheric pressure of a differential pressure room with high precision.

[0060] According to the laser metering device according to claim 8, since either of the claims 4-7 is equipped with the atmospheric pressure control unit of a publication, it becomes possible to suppress the atmospheric pressure change on the optical path of a light beam, and to perform highly precise position measurement by the laser beam.

[0061] Since it has the laser metering device according to claim 8 which measures one [at least] position of a mask stage or a substrate stage according to the aligner according to claim 9, **** of atmospheric pressure change can be suppressed, with high precision, it can coordinate-measure, and a mask or a substrate can be positioned, and exposure precision can be raised.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the rough whole block diagram showing the atmospheric pressure control method concerning this invention and equipment, the laser metering device using this, and the aligner in 1 operation gestalt of an aligner.
[Drawing 2] It is the whole block diagram showing the atmospheric pressure control method concerning this invention and equipment, the laser metering device using this, and the laser metering device of the wavelength Tracker method in 1 operation gestalt of an aligner.
[Drawing 3] It is the outline block diagram showing the chamber and atmospheric pressure control unit in 1 operation gestalt of the atmospheric pressure control method concerning this invention and equipment, the laser metering device using this, and an aligner.
[Description of Notations]
14 Pressurized Room (Differential Pressure Room)
15 Adjustable Blower Fan
13 Adjustable Shutter
17 Adjustable Bulb
APC Atmospheric pressure control unit
CH Chamber
L The optical path of a light beam
LM Laser metering device (position metering device)
MCS Main-control system (controlling mechanism)
PL Projection optical system (criteria section)
S1 Outside atmospheric pressure sensor
S2 Inside atmospheric pressure sensor (chamber atmospheric pressure sensor)
S3 Pressurized-room atmospheric pressure sensor (differential pressure room atmospheric pressure sensor)
RST Reticle stage
R Reticle (mask)
W Wafer (substrate)
WST Wafer stage (a measurement object, moving part)

[Translation done.]

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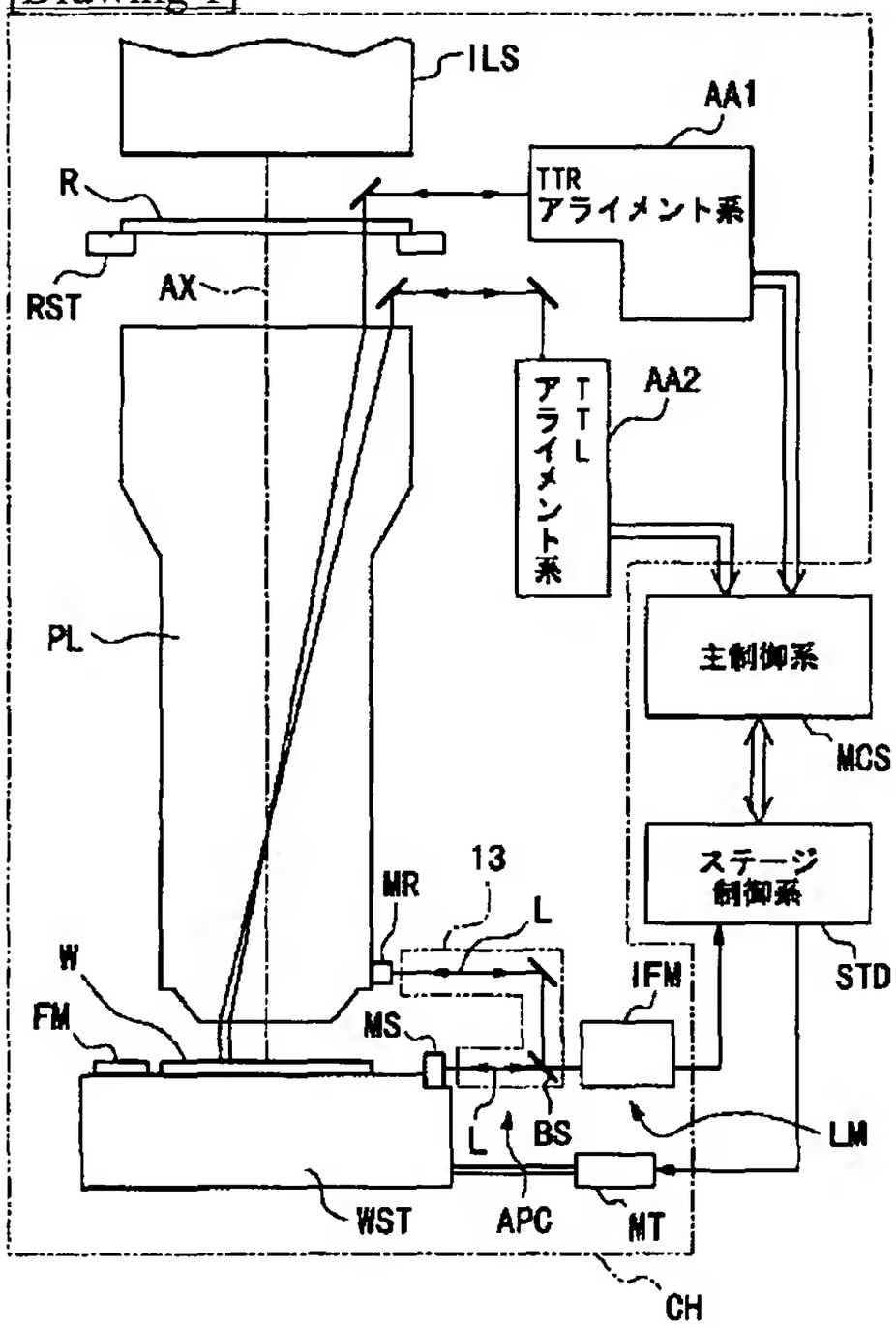
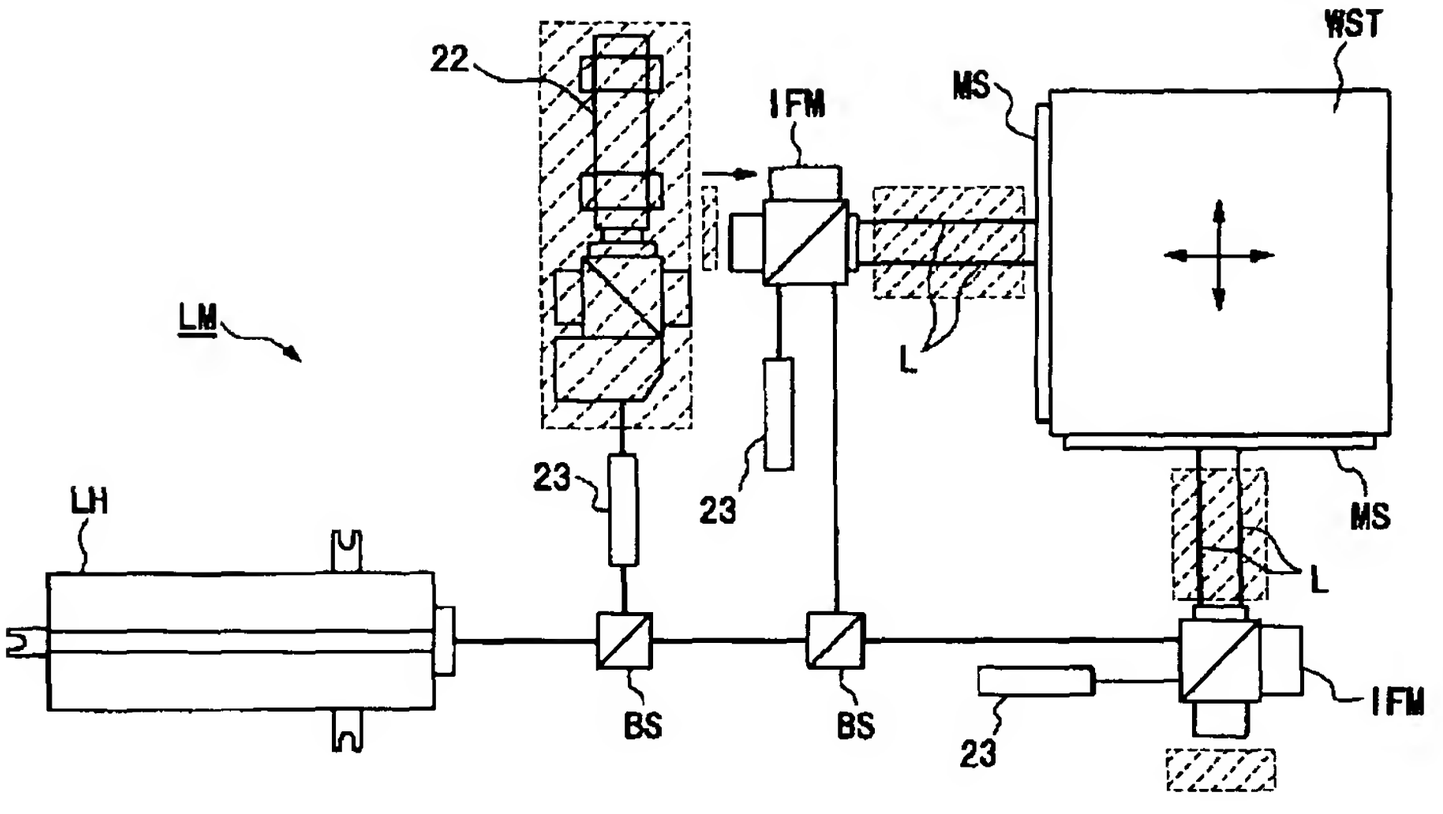
DRAWINGS

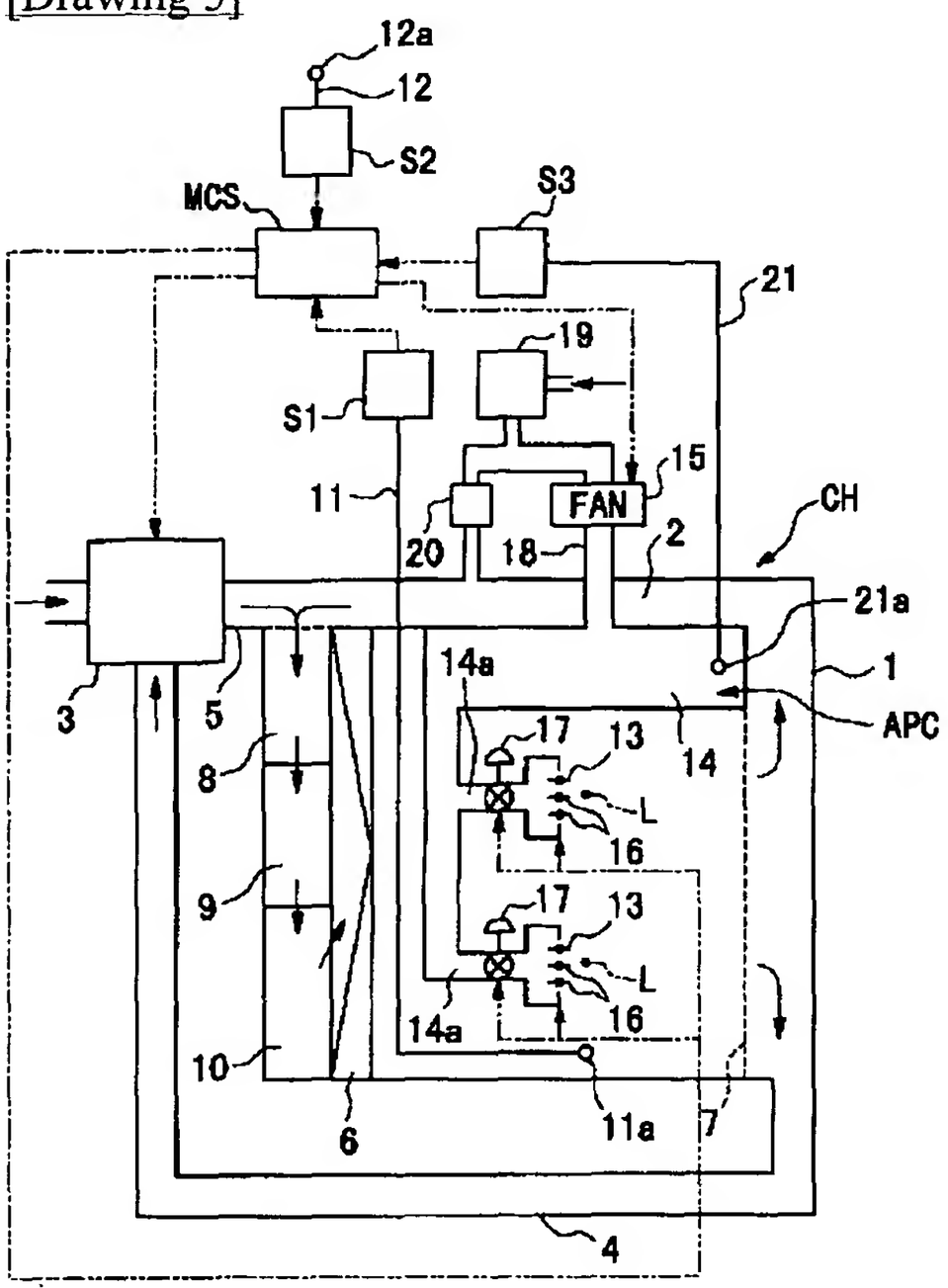
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]